New (Internal) Wave Generation - Laboratory Experiments

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Abstract

In this fluid dynamics video, we demonstrate the experimental generation of various internal wave fields using a novel wave generator. Specifically, uni-directional internal wave beams and vertical modes 1 and 2 are generated and visualized using Particle Image Velocimetry. Further details and analysis of these experiments can be found in [1].

The first one minute of this three-minute video shows the working and assembly of the wave generator. In all the experiments shown, quantitative velocity field measurements were performed using Particle Image Velocimetry.

The 1:00-1:40 section of the video presents the generated wave field for wave beam experiments. The phase of the oscillating plates in these experiments travels upwards (0:54-1:03), and this ensures that the emitted wave field propagates predominantly downwards. The first experiment (1:04-1:24), performed in a linear density stratification with buoyancy frequency $N = 0.85$ rad/s, corresponds to $\omega = 0.22$ rad/s, and produces a wave beam that propagates at an angle $\theta = \sin^{-1} \frac{\omega}{N} = 15^\circ$ with respect to the horizontal. In the second experiment (1:25-1:40), the forcing frequency is increased to $\omega = 0.6$ rad/s (with the value of N the same as before), and we observe a wave beam that propagates at $\theta = \sin^{-1} \frac{\omega}{N} = 45^\circ$. The generated and the reflected (off the bottom of the tank) wave beams interfere to form a striking array of vortices.

The 1:40-2:15 section of the video shows how one can excite vertical mode 1 internal waves using the wave generator. Forcing the horizontal velocity

in the shape of mode-1, we observe a traveling internal wave that spans the entire height of the fluid. The final section demonstrates the generation of mode-2 internal waves in a similar manner. These experiments, which correspond to $N = 0.85$ rad/s and $\omega = 0.6$ rad/s, prove that the generator can excite distinct modes with remarkable efficiency.

High and low resolution versions of the video can be found at final_high_res.mpeg (1.38 GB) and final_low_res.mpeg4 (9.47 MB), respectively.

References

[1] Mercier, M., Martinand, D., Mathur, M., Gostiaux, L., Peacock, T., & Dauxois, T. 2009 New (internal) wave generation, *J. Fluid Mech.*, submitted.